

IN THE CLAIMS:

Please cancel without prejudice claim 7.

Also kindly change claims 1 through 6, and claim 21, all to read as follows.

1 1. (currently amended) Apparatus for printing images on
2 a printing medium, by construction from individual marks;
3 said apparatus being characterized by a design value for
4 printhead-to-printing-medium spacing (PPS), and
5 comprising:

6 printheads carried on a scanning carriage next to a
7 printing-medium position;

8 a single-channel optical sensor having:

9
10 plural lamps emitting substantially incoherent
11 light,

12
13 means, including a photosensitive stage, for
14 receiving and responding to the substan-
15 tially incoherent light, and for develop-
16 ing therefrom a sensor output signal rep-
17 resenting at least one difference between
18 PPS measurements with a corresponding pair
19 of the lamps;

20
21 said photosensitive stage being calibrated, with
22 each of the plural lamps, at the design value of PPS; and

23 means for interpreting the at least one difference
24 signal as a PPS displacement from the design PPS value,
25 to determine actual PPS in the printer

26

27 ~~a platen locating such medium;~~
28 ~~— at least one printhead marking on such medium;~~
29 ~~— a carriage holding the head;~~
30 ~~— a rod supporting the carriage for scanning motion~~
31 ~~across such medium;~~
32 ~~— a sensor, at least partially mounted to the car-~~
33 ~~riage, measuring relative distances between the sensor~~
34 ~~and the platen or such medium, said sensor comprising~~
35 ~~first processor portions interpreting intensity of~~
36 ~~reflected radiation, at each of plural positions along~~
37 ~~the scanning motion respectively, as a measure of respec-~~
38 ~~tive transmission distances from the source to the sensor~~
39 ~~via reflection from the platen or such medium; and~~
40 ~~— second microprocessor portions modifying the marking~~
41 ~~by the head to compensate for variation of the measured~~
42 ~~distances during the scanning motion.~~

1 2. (currently amended) The apparatus of claim 1, where-
2 in:
3 the receiving and responding means comprise means
4 for using the sensor with:
5
6 the pair of lamps in alternation to develop an
7 a. c. signal output representing said at
8 least one difference, and
9
10 another pair of lamps in alternation to develop
11 another a. c. signal output representing
12 another difference;
13
14 the interpreting means comprise means for computing
15 a mean of the differences; and
16 the computing means comprise means for weighting the
17 differences in an inverse relation to signal noise asso-
18 ciated with each difference
19
20 ~~the sensor further comprises:~~
21 ~~— a radiation source emitting radiation toward the~~
22 ~~platen or such medium;~~
23 ~~— a detector receiving source radiation reflected from~~
24 ~~the platen or such medium.~~

1 3. (currently amended) The apparatus of claim 1, fur-
2 ther comprising:
3 means for applying a signal from the sensor to com-
4 pute a profile of said PPS along said scanning, using a
5 known correlation function;
6 means for measuring intensity variations of re-
7 flected radiation received on the surface along said
8 scanning;
9 means for interpreting the intensity variations as
10 directly due to attenuation in travel of the radiation
11 toward the printing-medium position and back;
12 means for retaining the interpreted intensity-varia-
13 tion information for use in compensating imperfection;
14 and
15 means for adjusting marking positions of the print-
16 heads, based on the computed PPS profile
17
18 ~~wherein:~~
19 ~~—— the radiation source emits substantially incoherent~~
20 ~~radiation; and~~
21 ~~—— the sensor is a single-channel device.~~

1 4. (currently amended) A method of compensating opera-
2 tion of a printer, which printer has printheads carried
3 on a scanning carriage next to a printing-medium posi-
4 tion; said method comprising the steps of:
5 scanning a surface substantially at the printing-
6 medium position using a single-channel, plural-lamp opti-
7 cal sensor operating with substantially incoherent light;
8 defining a design value for printhead-to-printing-
9 medium spacing in the printer;
10 calibrating the sensor, with each of plural lamps
11 associated with the sensor, respectively, at the design
12 PPS value;
13 installing the calibrated sensor in the printer;
14 operating the sensor, with each of the plural lamps
15 respectively, in such a way as to develop a sensor output
16 signal representing at least one difference between PPS
17 measurements with a corresponding pair of the lamps; and
18 interpreting the at least one difference signal as a
19 PPS displacement from the design PPS value, to determine
20 actual PPS in the printer
21
22 ~~The apparatus of claim 1, wherein:~~
23 ~~— the sensor comprises means for measuring the rela-~~
24 ~~tive distances without printing on such medium.~~

1 5. (currently amended) The method apparatus of claim 4
2 [[1]], wherein:
3 the operating step comprises using the sensor with:
4
5 the pair of lamps in alternation to develop an
6 a. c. signal output representing said at
7 least one difference; and
8
9 another pair of lamps in alternation to develop
10 another a. c. signal output representing
11 another difference;
12
13 the interpreting step comprises computing a mean of
14 the differences; and
15 the computing comprises weighting the differences in
16 an inverse relation to signal noise associated with each
17 difference
18
19 ~~the sensor comprises means for measuring the rela-~~
20 ~~tive distances at multiple positions substantially along~~
21 ~~the length of the rod.~~

1 6. (currently amended) The method apparatus of claim 4,
2 further comprising the steps of:

3 applying a signal from the sensor to compute a pro-
4 file of said PPS along said scanning, using a known cor-
5 relation function;

6 measuring intensity variations of reflected radia-
7 tion received on the surface along said scanning;

8 interpreting the intensity variations as directly
9 due to attenuation in travel of the radiation toward the
10 printing-medium position and back;

11 retaining the interpreted intensity-variation
12 information for use in compensating imperfection; and

13 adjusting marking positions of the printheads, based
14 on the computed PPS profile

15

16 ~~1, wherein the modifying means comprise:~~

17 ~~—— memory storing the respective transmission-distance~~
18 ~~measures for the plural positions; and~~

19 ~~—— third microprocessor portions for retrieving the~~
20 ~~transmission-distance measures for the plural positions,~~
21 ~~to use in compensation, by the second portions, for cor-~~
22 ~~responding positions along the rod respectively.~~

1 7. (canceled)

1 8. (original) A method of compensating operation of a
2 printer, which printer has printheads carried on a scan-
3 ning carriage next to a printing-medium position; said
4 method comprising the steps of:
5 scanning a surface substantially at the printing-
6 medium position using a single-channel optical sensor
7 operating with substantially incoherent light;
8 applying a signal from the sensor to compute a
9 printhead-to-printing-medium spacing (PPS) profile along
10 said scanning, using a known correlation function;
11 adjusting marking positions of the printheads, based
12 on the computed PPS profile.

1 9. (original) The method of claim 8:
2 further comprising the step of loading unprinted,
3 bare printing medium into the printer; and
4 wherein the surface-scanning step comprises scanning
5 the unprinted, bare medium.

1 10. (original) A method of calibrating a printer, which
2 printer has printheads carried on a scanning carriage
3 next to a printing-medium position, and has a carriage
4 support-and-guide rod subject to imperfection in geomet-
5 rical relation with the printing-medium position; said
6 method comprising the steps of:

7 projecting radiation from the carriage toward the
8 printing-medium position for reflection back toward the
9 carriage, at plural locations of the carriage along the
10 rod;

11 measuring intensity variations of reflected radia-
12 tion received on the carriage at the plural locations;

13 interpreting the intensity variations as directly
14 due to attenuation in travel of the radiation through the
15 distance from the carriage toward the printing-medium
16 position and back to the carriage; and

17 retaining the interpreted intensity-variation infor-
18 mation for use in compensating the imperfection.

1 11. (original) The method of claim 10, wherein:

2 the projecting step comprises projecting the radia-
3 tion to a printing medium disposed at the printing-medium
4 position;

5 the measuring step comprises receiving the radiation
6 reflected from the printing medium; and

7 the attenuation is due to scattering of the radia-
8 tion in the reflection, and divergence of the radiation
9 during said travel.

1 12. (original) The method of claim 11, wherein, during
2 said projecting and receiving :
3 substantially nothing has been printed on the print-
4 ing medium;
5 whereby the printing medium is substantially bare
6 printing medium.

1 13. (original) The method of claim 10, wherein:
2 the projecting step comprises projecting the radia-
3 tion to a platen disposed substantially at the printing-
4 medium position; and
5 the measuring step comprises receiving the radiation
6 reflected from the platen.

1 14. (original) The method of claim 13, wherein:
2 the interpreting step comprises making a distance
3 allowance for thickness of printing medium absent from
4 the platen.

1 15. (original) The method of claim 10, wherein:
2 the interpreting step comprises referring to a
3 previously determined correlation function between inten-
4 sity variation information and printhead-to-printing-
5 medium spacing.

1 16. (original) A method of determining printhead-to-
2 printing-medium spacing (PPS) in an incremental printer,
3 using a plural-lamp sensor; said method comprising the
4 steps of:
5 defining a design value for PPS in the printer;
6 calibrating the sensor, with each lamp of the
7 plurality respectively, at the design PPS value;
8 installing the calibrated sensor in the printer;
9 operating the sensor, with each lamp of the plural-
10 ity respectively, in such a way as to develop a sensor
11 output signal representing at least one difference be-
12 tween PPS measurements with a corresponding pair of the
13 lamps; and
14 interpreting the at least one difference signal as a
15 PPS displacement from the design PPS value, to determine
16 actual PPS in the printer.

1 17. (original) The method of claim 16, wherein the
2 operating step comprises:
3 using the sensor with the pair of lamps in alterna-
4 tion to develop an a. c. signal output representing said
5 at least one difference.

1 18. (original) The method of claim 17, wherein:
2 the operating step further comprises using the sen-
3 sor with another pair of lamps in alternation to develop
4 another a. c. signal output representing another differ-
5 ence; and
6 the interpreting step comprises computing a mean of
7 the differences.

1 19. (original) The method of claim 18, wherein:
2 the computing comprises weighting the differences in
3 an inverse relation to signal noise associated with each
4 difference.

1 20. (original) The method of claim 19, wherein:
2 the computing comprises finding said mean as a root-
3 mean-square of the weighted differences.

1 21. (currently amended) Apparatus for printing an image
2 on a printing medium, by construction from individual
3 marks; said apparatus comprising:
4 a platen locating such medium;
5 an array of printing elements marking on such
6 medium, said array being of length at least as great as
7 width of such image;
8 an advance mechanism providing relative motion of
9 such medium and the array, substantially at right angles
10 to the array length;
11 a carriage scanning lengthwise along the array;
12 a sensor, at least partially mounted to the car-
13 riage, measuring relative distances between the sensor
14 and the platen or such medium; said sensor comprising
15 first processor portions interpreting intensity of
16 reflected radiation, at each of plural positions along
17 the scanning motion respectively, as a measure of respec-
18 tive transmission distances from a [[the]] source to the
19 sensor via reflection from the platen or such medium; and
20 second microprocessor portions modifying the marking
21 by the array to compensate for variation of the measured
22 distances along the array length.

1 22. (original) The apparatus of claim 21, wherein:
2 the carriage carries exclusively the sensor or por-
3 tions thereof, not the array.